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EDITORIAL

Soil Fertility

THE art of cultivation is as old as man, his very life has depended on its practice. Rough-and-ready methods, differing according to circumstances, have been followed the world over; frequent failure and fertility of resource have brought cultivation gradually but surely to its present state of development. It is only of recent years that the sciences which bear on cultivation have reached a stage where they are in touch with reality and become a powerful aid to practice. Now that it has become possible to state the problems of cultivation with some amount of detail, the way is indicated for their solution. The knowledge of inorganic fertilizers has laid one bogy for ever, the fear of our not being able to produce sufficient food to supply the growing population of the world. Indeed the reverse is the fact; there is over-production of most crops, a corresponding lessening in their price and a need for cheaper production. The factor of quality is beginning to play a part: in time to come it may be predominant and the grower may be asked to produce products of greatest food value and not just crops. Most, if not all, diseases of plants are proving to be deficiency diseases and curable by proper manurial treatment, just as many of our own ills are attributable to the same cause and are preventable by proper feeding. So too the ills of farm animals, *e.g.*, tuberculosis in cattle, are preventable if the proper dietary measures are taken and they should be so prevented by law if not by public opinion; it is improper that 10% of the milk which comes to London should be infected. Such diseases as the well-known black spot, the worst enemy of the rose, may be prevented by the addition of ammonium phosphate, whilst the addition of potash alleviates leaf scorch in apples. Potash also offers a partial substitute for sunshine for it has been found at Rothamsted that its addition to the soil has a greater relative effect in sunless than in sunny seasons, apparently because it makes the chlorophyll machinery more efficient. When sunlight is deficient, potash also helps the development of the pigment in the skin of the apple; well might the fertilizer makers advertise "potash makes rosy apples!" The value of having things out of season is not confined to luxury articles, new potatoes or early strawberries, for it is equally important for the farmer to get an early bite on his pasture, to which end he must treat it with nitrogen fertilizer in the spring. A fortnight or more gained in this way of outdoor grazing saves the cost of expensive concentrated foods. In the spring all the grasses of a pasture respond to nitrogen and those which are naturally early in their growth respond first. If they are able to grow then they flourish, as they have the field very much to themselves. Later on they are in competition with the less early grasses and where there is nitrogen shortage the pastures in course of a few years become deficient in early grass so that the pasture becomes later and later and of less value to the farmer. A new lore is arising in regard to pastures based on the application of sufficient nitrogen in the spring: at last the superiority in every respect of young grass, in proteins, fats, carbohydrates, as well as accessory factors, is being realized. It is profitable to dress with nitrogen as often as three times in a season, as the vigorous early growth induced by it uses up the available supply and the pasture is once again hungry. We have heard criticisms of the unintelligent over-production of manufacturing capacity for synthetic nitrogenous fertilizers, but the fact is that the farmer could use so much more to his profit if only he understood the why and the how, enough indeed fully to occupy the potential capacity. Agriculture is going ahead again in Britain; recently we have been told by an authority that we produce enough to feed half the population, and the latest statements as to pig production are also encouraging. If the farmer will march with the chemist up the furrows and across the pastures, the outlook can be described as hopeful.

Research

Major Freeth when recently discussing the Mechanization of Research before the Liverpool Section of the Society alluded to a number of important aspects of research. He has on many occasions in the past made some valuable commentaries on research and discovery and he has done this again on the present occasion. Research and discovery differ as much almost as industry and genius; our English language is so ambiguous that perhaps we ought to say perseverance instead of industry. Many forms of industry do not involve mental work of an inspired or inspiring nature; more often they involve mental work of a fatiguing nature and this leads to a very different

class of result. Some workers of considerable ability are capable of the one sort of work and some of the other; very few are capable of both. Major Freeth is of opinion, and we are so presumptuous as to agree with him, that inventiveness or the spirit of discovery is independent of training and possibly flourishes in spite of rather than as the result of training. A student who wishes to talk French well must have time to practise it; one who wishes to indulge in original thought must be allowed time for original thinking. Lamb, in the *New Schoolmaster*, says: "Too frequent doses of original thinking from others restrain what lesser portion of that faculty you may possess of your own. You get entangled in another man's mind, even as you lose yourself in another man's grounds." One of the worst faults of our modern examination system seems to us to be that the young student's life is so full that he has little time for original thinking. Probably no remarks that we make in these columns will alter our examination system. Nevertheless the fact, so we believe, remains that modern conditions make original thought difficult and we are glad to find that so experienced a man as Major Freeth has some misgivings on this matter. We are also of his opinion in thinking that people accept far too readily what has been done and are content to rely on abstracts as conclusive evidence rather than as most useful signposts. Again it is hard to think of a remedy: the scientific student has a great deal to learn and he must accept the statements of his teachers and text books. Regarding Major Freeth's contention that there should be more study of the historical side of discovery we are better placed; here we can make a practical suggestion. We invite Major Freeth to gather together many of the acute observations and happy instances that he has already made use of in the past and to put forward in our columns a considered statement of the art of discovery, how and when it can be encouraged, how it can be discouraged, and what steps should be taken by the chemical world to improve matters, assuming any improvement is possible. Among the many qualifications he possesses for this task is his association with Imperial Chemical Industries, Ltd., who have long taken a very broad-minded, and sensible, and generous view of research, its conduct, and its needs. Their example is one that invites imitation. Major Freeth's opinions, excellent as they are, derive some further lustre from the fact that the deeds of I.C.I. do not lag behind the precepts that he so pleasantly enunciates.

The Insulin Case

The tribunal appointed under Section 1 (5) of the Safeguarding of Industries Act 1921 as amended by the Finance Act 1926 has had to decide whether insulin is a "fine chemical." It has come to the conclusion that it is, and its formal award is so brief that no one can call into question the reasons for coming to this decision. The members of the tribunal were the Hon. S. O. Henn Collins, C.B.E., K.C., Prof. F. G. Donnan, C.B.E., F.R.S., and Prof. S. Smiles, O.B.E., F.R.S. Four well-known chemists gave evidence to assist the tribunal to come to a decision on one side or the other: these were Prof R. Robinson, F.R.S., Prof. J. C. Drummond, Dr. F. H. Carr, and Dr. E. F. Armstrong, F.R.S. The problems were few but not easy to solve; it is not easy for a punctilious professor to say what is a "chemical." When he is thinking carefully such a substantive does not occur to his mind at all and such a man is no better guide to the meaning to be attached to such a loose phrase than many a junior chemist. The first problem to be solved seems to be to find what sort of standard is to be applied to the words "fine chemical"; no strictly scientific standard can be applied and what sort of standard was finally determined we do not know, nor does it matter. Opinions differed as to what is a "chemical" and we are not surprised; chemical compounds fade by infinitesimal steps into mixtures and the proteins are by no means the only instances of such gradation. As some of the witnesses pointed out there are mixtures of very similar compounds to be considered and we think it would be easy to name a score or more of substances upon which there would be a great diversity of opinion if an attempt were made to pick out those that were chemical compounds. There must always be such difficulties when material objects are concerned and yet an arbitrary line must be drawn somewhere to satisfy the demands of the Act of Parliament. It is not open to the tribunal to say "we do not know" to such a question as was put to them in this case. Insulin is a chemical: is it a "fine" chemical? Here again no exact scientific knowledge is of value in coming to a decision. It does not follow that a very learned man is a better judge of a fine day, or a fine woman, or fine clothes, or fine arts, or fine threads, or fine wines, than the unlearned and the same is true when we come to consider "fine chemicals." The wit of man could hardly have chosen a more inexact term than this and yet in the great majority of cases there would be unanimous judgments if it became necessary to say whether substances were fine chemicals or not. It was suggested that fine chemicals were those made by fine chemical manufacturers, but this is no more scientific than to define fine weather as weather in which fine women wear fine clothes out of doors. We think that those who frame Acts of Parliament might often be more fastidious, to choose words capable of exact interpretation. Hobbes said: "The light of humane minds is perspicuous words, but by exact definitions first snuffed, and purged from ambiguity." In spite of the difficulties with which they were faced we think the decision of the tribunal was in accordance with the majority of the evidence and is not likely to inflict any damage on the inhabitants of this country. We understand that the British manufacturers have published their intention not to take advantage of this decision by increasing the price of insulin.

COLOUR MEASUREMENT

By G. S. FAWCETT

Read before a joint meeting of the Bristol Section and the Institute of Chemistry on Nov. 2, 1933

The term " colour " is used to describe the quality of sensation which is stimulated when light falls upon the human eye. The formation of all colour is due to a sifting and removal or absorption of some of the vibrations of certain wavelengths which when combined form white light. If light falls upon a white object, practically all the light which falls upon it is reflected back to the eye and creates the sensation of white. Now, if that object does not reflect the whole of the light which falls upon it, but absorbs certain parts of the light, it will appear coloured.

Lights.—Thus light is an essential feature for the observance or appreciation of colour. With the first glimmer of light at dawn it is possible to perceive the blurred outline of large and distinctive objects, but these are visible only in varying shades of grey. As the light increases the outlines become more definite and eventually sharp and well defined. Gradually the different objects in the room appear to be of different colours. When the sun has risen over the horizon and it is daylight, minute detail is discernible and one is conscious, not only of different colours, but of slight variations in hue. If the sun shines directly into the room, further changes are noticeable and objects lying in the direct path of the sun's rays appear brighter and of a more vivid hue. In artificial light these colours are liable to change again. Thus it is impossible to describe or define the colour of objects unless the quality and intensity of the light are clearly stated.

It is by no means uncommon for two materials which match by daylight to be found to be not only a bad match, but frequently a most unsatisfactory combination when seen by artificial light. The reverse also occurs. In the laboratory it is possible to demonstrate other surprising effects: for instance, if we isolate the red end of the spectrum and allow it to fall upon a green object, that object will appear black. The same effect is produced by illuminating any object with a light on its complementary colour. Surroundings also affect the appearance of an object. Primrose on most colour charts is quite distinctly a yellow-orange whereas the actual flower is a pure yellow.

In September, 1931, an International Commission was held at Cambridge to define certain standard conditions to be adopted for purposes of colorimetry, and among other things it was decided that there should be three standard sources of light:

(1) A gas-filled lamp operated at a colour temperature of 2848° K., which shall be taken as normal artificial light; (2) the same lamp used in combination with a filter which shall be considered as equivalent to normal noon sunlight; (3) the same light used in combination with another filter which may be taken as equivalent to diffused daylight. The last resolution reads as follows:

" *For the purpose of colorimetric measurements* of reflecting materials, except where special circumstances dictate otherwise, the illumination should be incident at an angle of 45° and the line of observation should be normal to the surface of the specimen. Where the special nature of the material or the special objects of an investigation require a departure from these conditions, a statement of the actual conditions employed should always be included with any published results. In colorimetric measurements of opaque materials the brightness of the material shall be expressed relative to the brightness of the surface of magnesium oxide under the same conditions of illumination."

This was a step in the right direction, as hitherto it had been impossible to get any large number of persons to agree as to how colours should be compared, tested, or matched. The practice in most colour-producing industries has been to work in North daylight, which is certainly ideal when available, but under modern conditions it is seldom available on account of smoke and fog, and of overshadowing buildings in congested areas. It is also necessary to continue activities after dark, so that it is of the greatest value to have a standard light for reference purposes. The last of the three specified lights is the one with which we are most concerned; it is not equivalent to North daylight but resembles it closely and has the advantage of being constant and reproducible within permissible limits.

DIFFERENT METHODS OF MEASURING COLOUR

Until comparatively recent times no serious attempt had been made to define colours in terms of any definite set of standards: there were no principles laid down stating how colours could be recognized and defined, and, in fact, confusion reigned. With the commercial advances which were made in the last century and the scientific discovery made in laboratories, it became apparent to many that some means of defining and specifying colours must be evolved, and it was with this intention that my grandfather, J. W. Lovibond, set to work with his Tintometer. He found the necessity for a standard colour in his own industry, namely, brewing. He was convinced in his own mind that the bright amber-coloured beers were those of the best flavour, and his object was as far as possible to maintain the best standard of quality. He soon discovered how unsatisfactory it is to maintain samples of the particular goods in

kind, and like most others who have been faced with a similar problem, attempts were made to produce identically the same colour compared with solutions composed of fast colours. But in practice there are very few really permanent colours, and he began to use brown glass slides. They proved so satisfactory in the brewing industry that he supplied them to a number of his associates and was approached by other industries to supply glass standards of other colours. That was the origin of the Tintometer.

Prior to this event, where any attempt was made to adopt standards of colour, it was by reference to entirely arbitrary samples, which bore no relation to each other, but were filed and classified in the hope that they would not change and could be referred to when required. Several attempts have been made to compile charts or albums of colours showing patterns of as wide a range as possible and classifying them under different methods. Probably the best known chart of this type is one published by Munsell in America. There is a form of apparatus which is generally referred to as a colorimeter, but which should, I think, be more correctly described as a comparator, whereby a definite thickness of the unknown solution is compared against a variable column of solution of known strength. This gives no standard of reference in the strict sense. Apart from such methods of comparison against entirely arbitrary standards, colorimetry may be: (1) Subtractive, whereby white light is split up or absorbed by filters or standards of known absorptive value; (2) additive, whereby lights of specified wavelengths are mixed together to match any desired colour. Of the former type the Lovibond Tintometer is probably the best known, the most extensively used, and I believe the original. Another instrument based on the same principle, whereby coloured wedges are used, was designed by L. A. Jones and marketed by the Kodak Co. Of the second type the best known are by Ives and Guild. These are known as trichromatic colorimeters and are dependent upon the mixture of three known wavelengths. Ives in his instrument formed a spectrum and isolated three bands by variable slits and allowed the light which passed through these slits to focus on a given area. The colour of this area could then be varied by altering the opening of these slits, and the results were expressed by the size of the opening. The difficulty in this form of colorimeter is to obtain sufficiently bright or intense colours.

In the Guild colorimeter there are three variable windows, each of which is covered by a filter which only passes light of known wavelength. Actually these are red, green, and blue, and when the three windows are fully open and the light is focused upon a given area it appears white. Provision is also made for the mixture of white light, so as to obtain brighter and more intense colours than would otherwise be available. This instrument is the standard apparatus used at the National Physical Laboratory, and is undoubtedly, from a purely research point of view, of extreme value, but can only be operated by a trained and highly-skilled observer, and apart from research institutions is not extensively used in commerce.

The object and purpose of colour measurement are frequently questioned, but the occasions on which colour measurement is necessary are readily apparent. It is frequently necessary to know the behaviour of certain substances under specified conditions, whilst innumerable laboratory tests are performed which are entirely dependent upon change of colour. In commerce many substances are valued upon their colours, and many if they fade or change colour become valueless.

THE LOVIBOND COLOUR SCALE

By means of the Lovibond Tintometer, all colours can be accurately matched and recorded in comprehensible terms of physical standards which are easily available and always reproducible. These standards make up the Lovibond colour scale, which consists of a series of red, yellow, and blue glass slides which vary from the least amount of colour the normal eye can perceive to dark or intense colours. These three series of slides are so graded that equal intensities of the three colours when superimposed upon each other absorb a certain proportion of all the colour rays of which white light is composed, and appear grey or neutral tint. By combining these colour slides in suitable intensities any colour can be matched. Orange colours are matched by the combination of red and yellow slides. On the Lovibond colour scale pure orange will be matched by equal intensities of the two colours, whereas a yellow orange will be matched by combining a yellow slide with a red slide of lesser value. Greens are reproduced by combining blue and yellow slides, and violets by combining red and blue slides.

Now colour may vary in three directions, firstly hue. The hue is determined by the purity of the colour, *e.g.*, if it is a pure red, the colour can be matched by a single red slide, but if for instance it is a red with a bluish hue, then it will be necessary to introduce a certain amount of blue and the colour will be expressed as a red violet. Secondly there is saturation of colour, which is defined by the numerical value of the slides used to produce the colour match, and the third dimension is brightness, which may be described as normal if the colour can be matched by one or a combination of two colours from the Tintometer colour scale. If the three scales are necessary to match a colour, it means that there is a certain amount of grey or neutral tint present, and the quantity is determined by the value of the slide of lowest numerical value. *E.g.*, with a reading 7 red, 4 yellow, 1 blue, there is present 1 degree of neutral tint. This leaves three units of yellow and six units of red, but red and yellow form orange, so that there are three units of orange with an excess of three units of red, that is a dull red orange.

The brightness may be greater than the brightness of either one or a combination of two of the

tintometer slides, and in order to match these colours it is necessary to introduce between them and the eye of the observer, neutral tint slides of sufficient value to decrease the brightness, until the colour can be matched exactly by one or a combination of two of the primary colour scales.

The application of the colour scale not only provides physical standards for comparison purposes, but it also provides a complete and comprehensive colour nomenclature.

Now the Lovibond colour scale has been in existence for a considerable number of years and has been employed with undoubted success in a vast number of industries, but with the changed conditions of recent years it has been necessary to modify the apparatus in which the scale is employed. Thanks to the suggestion of Mr. T. Tusting Cocking of The British Drug Houses, Ltd. it has been possible to place on the market a very much improved and more convenient form of instrument with the name The Lovibond Tintometer, The British Drug Houses Pattern.

This instrument consists of a viewing tube with an eyepiece at one end and two apertures cut in one side of the tube at the other end, but not in the same horizontal plane when the tube is held vertically. Immediately behind these two apertures are placed two mirrors at 45°, so that any light entering the apertures and falling upon the mirrors is reflected towards the eyepiece. This viewing tube fits into a rectangular recess in a Bakelite box, which can be drawn apart near its centre, and the lid of which is pierced with a number of parallel slots. In the side of the box furthest from the eyepiece are two more rectangular apertures placed immediately opposite the mirrors in the viewing tube, so that light can pass through the box on to the mirrors and thus to the eyepiece. A number of small Bakelite racks or frames fit into this box and slide laterally along the slots in the lid. Provision is made for red, yellow, and blue slides to be fitted into these racks, so that as each rack is moved from left to right each slide in turn in the rack intercepts the beam of light entering the upper of the two apertures in the box before it reaches the mirror. The purpose of the other aperture is to permit light, either transmitted through the substance being tested or reflected from the surface of the sample, to enter the box and be reflected in the left-hand or lower mirror up the viewing tube to the eyepiece. These two mirrors are seen in juxtaposition with only a knife-edge separation so that the colour visible in the two mirrors can easily be compared. The procedure when matching a sample is to place it so that the light from it is reflected in the lower of the two mirrors and then move the coloured knobs which control the Bakelite racks from left to right until the two fields of view appear to be exactly the same colour.

The value of the slides effective in the instrument can then be read from the indicator in the lid at the left-hand extremity of each slot.

The original Lovibond colour scale was intended for use with diffused North daylight, but this is not always available, and in view of the fact that the International Commission laid down standards of illumination for purposes of colorimetry, artificial light attachment has recently been added which as nearly as possible complies with the conditions specified by the Commission. It consists of two 60-Watt "Pearl Osram" lamps in metal housings and two stipolite glass screens through which the light passes, so as to correct it as nearly as possible to daylight, and a block of carbonate of magnesia illuminated at 45° by a lamp from either side, the surface of the magnesia reflecting a white light into the two mirrors in the instrument. When testing the colour of opaque substances, the magnesium block in front of the left-hand or lower mirror is removed and the sample is placed so that its surface is in the same plane as a smaller magnesium block reflected in the upper mirror, and then the colour measured in exactly the same manner as when testing liquids. The original design of this attachment was worked out in our own laboratory at Salisbury, but has been modified at the suggestion of certain workers in other laboratories, of whom I particularly wish to mention the Glaxo Laboratories, the Dairying Research Laboratories at Shinfield, near Reading, and the British Drug Houses, Ltd. This attachment is very versatile and can be used in several positions according to the nature of the substances being tested, and if it be necessary to test the colour of long columns of liquid an extension can be fitted so that cells up to 18 in. or even 2 ft. long can be employed.

The Tintometer is primarily used as a colorimeter to define and specify the colour of objects so that these colours may be referred to and if necessary reproduced. It is used in the oil industry for determining the degree to which oils have been refined, and is useful for testing the fastness to light of such things as paints, dyes, printing inks, etc. It is possible to plot fading curves showing exactly how much any of these materials change in a given time under specified conditions. The vitamin-A content in cod-liver oil and other substances is accurately determined by measuring the change in colour which takes place when antimony trichloride is applied to the unsaponifiable matter in the oil; the deeper the blue produced the greater the vitamin-A content. Mr. Norman Strafford of Imperial Chemical Industries, Ltd. recently made references to tests with the Lovibond Tintometer for determining minute amounts of copper, aluminium, and magnesium.

It is also possible to estimate the amount of hæmoglobin in the blood by measuring the colour of the blood. These are only a few of the many applications to which the Tintometer can be placed, and recently the colour standards have been used for determining H-ion concentration of liquids by standardizing the colour changes which take place with certain indicators.

STATISTICAL METHODS IN INDUSTRY

The first meeting of the Industrial and Agricultural Research Section of the Royal Statistical Society was held on November 23, when Dr. R. H. Pickard, F.R.S., last year's president of the Society of Chemical Industry, gave an address on "The Application of Statistical Methods to Production and Research in Industry," a summary of which follows.

SPECIFICATION OF MATERIALS

It is a characteristic result of the present methods of educating scientists that the budding worker expects a unique figure to characterize a single property of a material. We speak of the elastic *constant* of a metal, and expect a given steel to have a single breaking strength which may suffice. But if one were asked to give the strength of a cotton yarn, even if its fineness and quality were defined, a single figure would not suffice for any purpose. Different test specimens from the same batch of yarn vary in strength by 50% to 100% or more, according to the quality of yarn and the method of testing. Clearly, some account must be taken of this variation in forming a specification, and the problem is essentially a statistical one. Most textiles, and leather and timber, to mention only a few very important materials, show this variation to a marked degree, and I believe that even the more regular materials like the metals vary somewhat from specimen to specimen within the same batch and also from batch to batch.

Closely related to the question of specification is that of sampling. How many tests are necessary for a given degree of accuracy? How should the units in the sample be chosen? For example, in sampling raw cotton, is one handful representative of a bale (500 or 700 lb.), and is one bale representative of a consignment? Is it better to choose 500 hairs singly, say, 50 from each of the 10 bales in a consignment, or should they be chosen in tufts of 50? In sampling a hide, it does matter from which part the specimen is taken: there are more or less systematic variations, so that a specimen taken from a definite part is a more precise index of the hide as a whole than a piece taken at random. These are questions which involve statistical investigations of the extent and nature of the variations that exist in the material in question, and when it is remembered that there may be variations within a unit, between units in the same consignment, between consignments from one source of supply, between sources of supply and between batches supplied at different seasons, it will be seen that the problem is in general very complex, and may involve a highly specialized statistical technique as well as technical knowledge.

RESEARCH IN INDUSTRY

A large part of the work of the scientist in industry consists of conducting experiments to find the effect of variations in one factor or another. The benighted chemist or physicist who has not yet learnt how to deal with uncontrolled and often uncontrollable variation is fortunate in that he works in a laboratory where all factors are under more or less complete control. For him, experimentation consists in varying one factor at a time and measuring the resultant effect. Sooner or later, however, if he becomes associated with industry, he will probably have to deal with inherently variable material, and it is then that his difficulties will arise. Even if he continues to work in a laboratory, he will find that there are uncontrollable variations, and he will be well advised either to consult a statistician or, better, to read a little statistics for himself.

Not all industrial research is done in laboratories, but frequently trials have to be carried out in factories. After a result relating to a manufacturing process is obtained in the laboratory, it is usually best, if practicable, to try it out on a large scale before using it. Inevitably, the degree of control possible is very much less in a factory than in a laboratory, and it is sometimes a difficult matter to disentangle the different causes and effects in order to measure the relationships between the two under investigation.

Experiments of fairly simple type are almost daily carried out by technical men and managers themselves, in order to discover if, for example, raw material from one source gives a better product than that from another, or if there is any advantage in some particular processing modification.

In all investigations of these kinds, whether in laboratory or factory, statistical principles should be consulted in designing the experiment. The aim should be to ensure that the uncontrolled variations are "*balanced out*" as far as possible (*i.e.*, so that they affect the parts of a comparison equally) and that such uncontrolled variations as are not "balanced out" shall be sufficiently "averaged out" to make the results significant. In this connexion, agriculture and industry, which usually make such uncomfortable bed-fellows, lie amicably together. It is in connexion with agricultural research that Prof. R. A. Fisher and his associates have developed certain principles of experimentation that are finding almost direct application to industry. To illustrate the advantage of good experimental design I may refer to some experiments carried out at the Shirley Institute to find the effect of various treatments on a quality of cloth. This quality varies considerably at different parts of the same piece of cloth, and in order to measure the effect of the treatments the tests are repeated systematically so that the variations are "averaged out." Some of the natural variation, however, is systematic, and by adopting a "Latin Square" arrangement of treatments on the cloth (such as is much used in agricultural yield trials), these systematic variations are eliminated from the comparison, and in the instance

and the result was to reduce by one-half the number of tests necessary for a given significance as compared with a random arrangement.* The advantage in balanced testing is not always as great as this in textile research, but one always has more confidence in the results when one knows that the experiment has been well arranged. In work of this kind, a statistician needs some technical knowledge, not only that he may know what variations may be balanced out, but also that the experiments may be so designed that they do not interfere too much with routine production in the factory. When the tests are finished and the data are available, statistical theory is necessary for testing the significance of the results.

Research workers in industry also have other types of investigation. They may have to devise some new laboratory test in order to express in figures properties which are recognized in practical life but are only appreciated subjectively and expressed qualitatively. In textiles, for example, the lustre of a fabric and its "feel" (*i.e.*, whether it is hard or soft, rough or smooth, stiff or lump) are of importance. Physical, physiological and psychological analysis are involved in suggesting suitable tests, but when the material is variable, there is also the difficulty of expressing the results (*i.e.*, of specification) and statistics comes to the rescue. Then the problem arises of measuring the extent to which the physical character actually does express the subjective quality, and this involves correlating the two. Sometimes the subjective quality is expressible in terms of a combination of physical characters, and then the statistician indulges in an orgy of multiple correlation in order to find the best weight to give each character in the combined result.

Exactly similar statistical technique is useful when the research worker has to find what physical characters measured on the raw materials are important in influencing the quality of the manufactured product, and when he has to determine a formula by which the final quality may be predicted from the results of tests on the raw material. In research on cotton, a considerable amount of work has been done in attempts to predict yarn quality from the results of various laboratory tests on raw cotton.

PROBLEMS OF MANAGEMENT AND PRODUCTION

I know that statisticians claim to be more than "mere tabulators" and that they are sometimes happier with a complicated problem than with a simple table of data that anyone can understand, but they will find that much of their use to industry lies in preparing and presenting such tables in suitable form. There are many production and management questions on which light is shed by comparatively simple data presenting a picture of things as they exist. For example, the rate of production in a particular factory may be only 70% of what it would be if the machines worked continuously. What are the causes of machine stoppage and how much of the loss in production may be attributed to each cause? It may be, for instance, that much of the loss is due to machines stopped for repair and that it would pay to buy some new machinery, or that there is an interruption in the supply of raw materials or of products of previous processes. Most managers know when their rate of production is reduced for this last cause, but they do not all know by how much it is reduced.

* Shirley Institute Memoirs, VII, 1929, 189 or *J. Text. Inst.*, 1930, XXI, T 105.

Another table of value is one recording the percentage of their time spent by various operatives in different parts of their duties. This is particularly useful where any question of re-organizing the work of the operatives arises, as, for instance, in the cotton-weaving industry, where many weavers are attending to six instead of the customary four "Lancashire" looms. Data somewhat of this kind have long been collected as "time-studies" for some industries, but I am thinking of analysing the work of all operatives, those who have a large variety of miscellaneous duties which change irregularly, as well as those who have a narrow range of repetitive operations. It would add to knowledge if the work of all operatives in all industries could be so analysed, and a picture be presented in tabular form.

Tables of the kind mentioned may suggest methods of improving efficiency or conditions at individual factories, but they may also be of use to the general manager of a large concern with many factories. He may not be able personally to investigate the organization of all the units, but with a series of tables before him he may obtain a good idea of the conditions at them all; he may compare one with another, or one type of organization with another. Indeed, it is only when such data are available that a science of management becomes possible.

I think, too, that in the future, the statistician will more frequently be called upon to obtain and provide information which will help the settlement of industrial disputes. In many of them there is disagreement as to facts, and it lies within the province of the scientist in general, and of the statistician in particular, to provide such objective data as are relevant.

THE STATISTICIAN AND INDUSTRY

I have said several times and I should like now to emphasize the fact that the statistician must know something of the industry to which he is going to apply himself. For success, close co-operation between the statistician and the technician is essential, and in order that they may have some common ground, at least one must know something of the other's work. At present, I am afraid that we must look to many statisticians to acquire that extra knowledge.

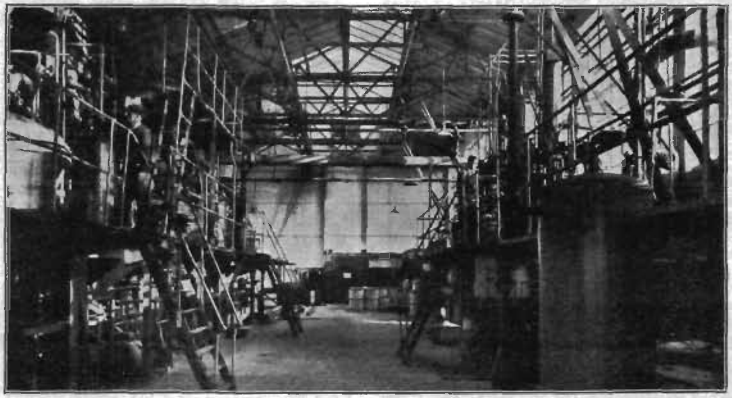
The statistician should also learn to present his conclusions in such a form that practical men can understand and make use of them. It is his duty to answer practical questions in generally intelligible terms; he must know what facts are relevant, and may even have to propound the questions. It frequently happens in applying science to practical affairs that the scientist has to see and state the problem as well as solve it! Statisticians may use all sorts of complicated constants like variances and correlation coefficients in arriving at their conclusions, but the answer should be stated in intelligible language.

BAKELITE, LTD.

Bakelite, Ltd. was formed in 1927 by an amalgamation of the Damard Lacquer Co., Ltd., Mouldensite, Ltd., and Redmanol, Ltd., a union which brought together several competing interests in the production of phenol-formaldehyde plastics. With the establishment of the fine factory we recently visited at Tyseley, Birmingham, the company has found a worthy home and one that will allow for future expansion.

The history of the company goes back well beyond the date of the amalgamation. It began in fact some twenty years earlier, when in 1906 the Fireproof Celluloid Syndicate was formed by Mr. J. Swinburne, F.R.S., the chairman of the present company. The Syndicate was taken over in 1910 by the Damard Lacquer Co., which commenced the manufacture of lacquers of the phenol-formaldehyde type under the Story patent. The lacquers soon became appreciated as worthy of their descriptive title "Damard" and it became necessary to move from the original small premises in London to larger ones at Bradford Street, Birmingham. Here, and in a factory acquired at Cowley during the war, production continued to expand, and in 1920 operations were centred in a factory at Greet, Birmingham. Meanwhile Mouldensite was being manufactured by Mouldensite, Ltd. and was earning a reputation for its excellent properties, and Redmanol, Ltd. were marketing in this country the phenol-formalin products of the Redman Chemical Products Co. of America, where it will be remembered there was considerable litigation with the Bakelite Corporation on the patent question. The Greet works were too small for the company which was formed in 1927, and a new factory was built not far away at Tyseley, and production was begun here in 1930.

So much for the history of the company, although our brief account has conveyed nothing of the trials of the pioneers of the industry, and the interest there has been in the development of something new both to chemical industry and the public. This quality of novelty was brought home to us as we passed through the Tyseley works, for one of its most striking characteristics is the complete difference from anything else which is to be seen in the chemical industry. This factory has been built solely for the manufacture of plastics, and in building it experience has been utilized by men who during the last quarter of a century have been elaborating their own technique.



BAKELITE RESIN DEPARTMENT

The raw materials, phenol and formaldehyde, are received in the works in tank wagons which discharge into storage tanks, and from these tanks the materials are conveyed as they are required by pipe lines to the adjacent resins department. This is a fine glass-roofed building with galleries running the length of both sides. On one side the gallery is concerned with the manufacture of resins for moulding powders; that on the other side with resins used in varnishes. Situated in the galleries are a number of digesters in which the phenol-formaldehyde reaction is effected and subsequent heat-treatment given. A modern

vacuum plant provides the means for transporting the materials. When the process is complete the resins are run off from the digesters through vents in the wall of the building, and are collected in shallow metal trays outside. Here they are allowed to cool and set, and an overhead crane then picks up the trays and carries them to the crushing and grinding department where the resins are reduced to powder in large disintegrators.

The remaining stages in the manufacture of moulding powders are then carried out in a building which is so arranged that there is a continuous flow of materials from the stores, where resins, fillers, pigments, etc. are kept, to the department in which the moulding powders are packed into drums for dispatch. Some 600 different coloured powders are made in this building, and the large number is some indication of the pitch of organization which has to be maintained. The greatest demands are for the familiar black and brown colours, although we believe moulders are somewhat fastidious concerning the exact shades of brown they require. The building is divided into several bays, in which the plant is repeated, and the black and brown products each have separate bays.

The resins, fillers, and pigments are taken first from the stores to a gallery which runs along the top storey of the building, and from this level they travel downwards through grinding and mixing plant until the floor level is reached. Batches of the finely ground mixture are then passed through hot calender rolls, which transform them to thin sheets of material which are pliable whilst hot, but which become brittle on cooling. It is interesting to note that this is the only stage of production at which the materials are handled, the remaining operations being wholly automatic. The operator is to be seen taking the hot sheets from the rolls and passing them through again several times until a requisite stage of consistency is arrived at, when the sheets are taken from the rolls and carried upwards by an elevator. Whilst one batch is being treated in the calender rolls the previous batch remains on the elevator at rest, and when the elevator is set in motion again to pick up the fresh batch, the first batch, which has now become cool and brittle, is thrown off from the top, to be passed once more through grinding and bulking plant, from which it passes as finished moulding powder into the drums placed ready for packing.

An interesting feature of this plant, apart from its automatic action and compact layout, is the use of Bakelite laminated gear wheels. This might be regarded as a demonstrative proof of the pudding, or at least practising what you preach, but actually such wheels have been used in the plant simply because the material has proved most suitable, strength being provided with also a welcome reduction of noise. At one point we saw a gear wheel of this sort transmitting the drive of a 50-h.p. motor.

The department in which these laminated materials are made was the next which we visited. The paper which is used in the manufacture of ordinary laminated Bakelite sheet is taken from huge rolls and over rollers, in the course of which it passes through a bath of impregnating resin, eventually being dried and run on to rolls at the far end of the plant. The process so described appears simple, but actually the operation of the machines is an intricate task, for the paper must be kept taut without risk of tearing, and the thickness of the coating of resin must be controlled by the speed of operation. The rolls of impregnated paper are then taken and cut into sheets of desired size, and the sheets are placed together in huge presses, in which, by the application of a pressure of 2,000 tons and at carefully controlled temperature, they are transformed into laminated sheets of material varying in thickness from $\frac{1}{100}$ in. to 2 in., according to the number of paper sheets used. Laminated material of great strength is made by the use of impregnated fabrics instead of paper; we saw a slab of this material about 4 in. thick, and it is from such slabs that gear wheels and other parts of heavy machinery are cut. By way of contrast, there was alongside this massive slab a thin laminated sheet in which the top lamina was a veneer of mahogany, and it seemed a very attractive material. In one section of this interesting department of the works tubes of impregnated material are manufactured, and another section is concerned with testing. It seems remarkable that sheets a yard or so square can be produced with thicknesses the variation of which does not exceed ·0015 in. for special purposes.

This is only one aspect of the testing carried out in the works. One large laboratory is reserved for tests of moulding powders, lacquers, varnishes, and laminated sheets to ensure that physical and mechanical properties are satisfactory. The equipment of this laboratory includes a 100,000-volt breakdown apparatus, and in this we saw a very thin sheet of laminated material resist the passage of some 70,000 volts before breaking down. Many other tests as important, if not so spectacular to watch, are carried out, and a control department keeps check of all the materials entering the factory. In addition there is a development department which is in effect an experimental factory, for it contains miniature models of digesters, presses, etc. which enable new processes to be tried out on a semi-commercial scale.

In this brief description we have been able to say only a little of the excellent buildings and the spacious layout of this factory in which Bakelite, the material "of a thousand uses," is made, and nothing of the thought which has been given to the welfare of employees. But if comment is needed, it can be said that the factory comes fully up to the standards that one expects from a company that has grown so quickly to be one of the most important in the chemical industry.

HELIUM RESEARCHES

Three lectures have been given recently by Prof. Fritz Paneth, until lately professor of chemistry at Königberg, at the Imperial College, London. Prof. J. C. Philip, F.R.S., was in the chair.

Prof. Paneth's first lecture dealt with the microscopic detection of helium. He separated helium from the other gases by passing the gases through hot calcium tubes and then charcoal which was cooled in liquid air. All gases, except hydrogen, neon, and helium, are adsorbed in the charcoal. The separation of helium and neon is not possible, but the separation of hydrogen is accomplished by drawing the gases through a red-hot spiral of palladium sealed at one end. Hydrogen passed through to the inside of the spiral, whilst neon and helium remained outside. The quantitative measurement on this remaining sample is done in the conduction apparatus, where a nickel wire carrying a current in an atmosphere of the gas is adjusted so that a steady state is achieved between the outer and inner surfaces of the gas. The measure of the square of the current necessary for a given condition of temperature of the outer surface gives the measure of helium present.

The second lecture was on the age of meteorites as determined by their helium content. Since all helium is believed to come from radio-active disintegration, a measure of the quantity of helium present gives the quantity of radio-active material originally present, and thus from Soddy's Law the age of the material can be found, the freezing of the planet being the time when helium began to remain in the material. Prof. Paneth found the ages of the many meteorites he examined never exceeded the age of this solar system, the inference being that meteorites come from this system and not, as some think, from other parts of the universe.

The third lecture was about transmutations, and the classic ones of J. T. Thomson (the bombardment of potassium iodide with cathode rays where helium was found) and Ramsay (the heating of evacuated bulbs by internal electrodes and the production of helium) were found by the lecturer to be false, the explanation being that the glass vessels when they became heated allowed helium to pass through the walls of the vessel from the atmosphere. Prof. Paneth proved this by keeping his apparatus cool in water baths. The late work of Cockroft and Walton was next discussed. Prof. Paneth said that on a repetition of this work he obtained no measurable quantity of helium: but this did not disprove Cockroft and Walton's work, as the alleged value for transmutated helium was smaller than was measurable on Prof. Paneth's apparatus, which could measure 1 in 10^9—10^{10} parts.

Prof. Philip thanked Prof. Paneth for very enjoyable lectures which were rendered in excellent English and enlivened by very clever humour. It is hoped that Prof. Paneth will lecture again shortly.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Decennial Index to British Chemical Abstracts. The preparation of the Decennial Index to Abstracts "A" and "B," covering the years 1923—32 is making great progress and it is hoped to publish the names' section early in 1934.

Those guarantors who ordered their copies with a deposit of 10s. in the early stages of its preparation will be called upon shortly to complete their preferential subscription by a further payment of £3 3s. 6d. To other members of the Society the price is £4 3s. 6d. and to the general public £8 (post free in all cases).

Subscriptions should be addressed to the Secretary, Bureau of Chemical Abstracts, 46, Finsbury Square, London, E.C.2, and remittances should be crossed "A/c Decennial Index."

Subscriptions, 1934. It will assist the work of the Accounts Department, which is very heavy in the early year, if members will remit their dues for 1934 as soon as possible.

Resignations. Any member wishing to terminate his membership must give notice in writing to the General Secretary before December 31. It is hoped that members who may have considered resignation will give careful thought to the heavy financial commitments of the Society and continue their membership in support of the essential work for which the Society is responsible.

AMERICAN SECTION

A joint meeting of the American Section of the Society with the American Chemical Society, the Electrochemical Society, and the Société de Chimie Industrielle was held at The Chemists' Club, New York City, on November 3, when the Chemical Industry Medal was presented by Prof. Marston T. Bogert to Mr. James G. Vail, of the Philadelphia Quartz Co. for his work on sodium silicates. The Chemical Industry Medal is an honour instituted this year by the Society of Chemical Industry, for award annually to a person making a valuable application of chemical research to industry, primary consideration to be given to applications in the public interest. The medal will take the place of the Grasselli Medal which has been awarded annually for a number of years by the Society and which has now been discontinued.

Dr. Walter T. Taggart described the work and accomplishments of Mr. Vail, who then presented an address on "The Culture of Certain Silicate Gardens," which will be published shortly.

LONDON SECTION

The December meeting of the London Section of the Society was held at Burlington House on Dec. 4, with Dr. J. J. Fox in the chair.

A paper was given by Messrs. E. A. Cooke and J. C. Swallow on "The Control and Measurement of Temperature in an Industrial Laboratory."

The lecture was admirably illustrated by slides, and by a demonstration of some of the electrical apparatus actually used.

In the discussion which followed, the authors were congratulated by several speakers on the remarkable precision of temperature control they had obtained over so wide a range of temperatures.

MONTREAL SECTION

The first University lecture for the season 1933—34 was delivered by Dr. W. H. Barnes to the members of the Montreal Section on Nov. 22 in the McGill Chemistry Building. The subject was "Chinese Alchemy."

The lecturer traced, in the most fluent manner, the development of Chinese alchemy and touched on its probable influence on European alchemy. The lecture was illustrated by lantern slides from Chinese sources, and was most entertaining. Dr. I. R. McHaffie acted as chairman, 75 members attending

Through the courtesy of McGill University these lectures are given by members of the staff of the Chemistry Department exclusively to the members of the Montreal Section of the Society of Chemical Industry, and they constitute a very important part of the programme of the Section.

YORKSHIRE SECTION

At the opening of the meeting held on Monday, Dec. 4, in the Medical School of the University of Leeds, a vote of sympathy was passed to the relatives on the occasion of the death of the late Mr. F. W. Branson. Prof. Comber, chairman, referred to the great services rendered to the Section by Mr. Branson, an original member of the Society, as a past chairman and at all times, as a member of the Committee or otherwise, by his readiness to give support and assistance to its activities. The large audience, including chairmen and members of the Leeds and Bradford branches of the Pharmaceutical Society, then heard Dr. F. H. Carr, C.B.E. deliver the Jubilee Memorial Lecture on "Biochemistry and the Manufacture of Fine Chemicals." After the lecture, which will be published in full at a later date, Prof. Challenger, expressing the audience's warm appreciation of the very valuable and interesting address, moved a hearty vote of thanks to Dr. Carr, which was seconded by Mr. J. H. Gough, chairman of the Leeds branch of the Pharmaceutical Society, and carried with acclamation.

RAMSAY CHEMICAL DINNER

The 11th Ramsay Chemical Dinner was held in the Central Station Hotel, Glasgow, on Dec. 8. This dinner, which is held in honour of Sir William Ramsay, is organized under the joint auspices of all the Glasgow sections of the chemical and allied societies.

The principal speaker of the evening was Sir Arthur Huddleston, who proposed the toast of "The Profession of Chemistry."

Sir Arthur said that nothing had brought home to him more clearly the position occupied by the Royal Technical College than the fact that he had been asked to take the chair at this dinner, and he greatly appreciated the honour. He then recounted his first meeting with a real chemist, as defined by the Institute of Chemistry. It had happened when he was a young district officer in the Sudan and had been investigating a murder. A smear of blood on a wall near the scene of the murder threw suspicion on a man who was known to be at enmity with the deceased. However, Sir Arthur sent the blood to be examined by the Government chemist at Khartoum and this analysis showed that the blood was bovine. Thus by the intervention of the chemist an innocent man was set free much sooner than would have been the case if the matter had been investigated in the usual way. The great help which had been given by chemists in the planning of the Sudanese irrigation scheme was recounted by Sir Arthur, who then went on to relate how amazed he had been when he had heard that it was proposed to appoint a chemist to the State railways. His amazement gave way to delight however when he saw a statement which clearly showed that the chemist had saved his salary many times over. This connexion of chemists with railways was brought back to his mind when he visited the Scottish station of the Fuel Research Board which is situated in the Royal Technical College. Here, under the direction of Mr. Skilling, a staff of workers is preparing a survey of the Scottish coal fields and Sir Arthur wondered if coal owners and consumers realized the benefits to be obtained from exact knowledge of coal. Sir Arthur also explained the attempts which had been made in the early 'eighties to establish a natural indigo industry in the Sudan. Before this industry was properly started the chemist produced synthetic indigo. The adjustment necessary in the Sudan, subsequent to the introduction of synthetic indigo, was not very serious as the natural industry had not been extensive, but in other countries such adjustment had been a very serious matter. It was one of the responsibilities of scientists that, by introducing new processes, they tended to displace labour from old industry. Sir Arthur said that it was his firm belief that, once the machinery of finance was again in full working order and the laws of supply and demand were following their normal course, the introduction of new processes would, in the long run, produce more work than they displaced. Adjustment would in the future be more difficult. Agricultural nations were becoming more industrialized and rationalization was converting local industries into national and even international industries, and labour was becoming less mobile, due to social legislation. To face these difficulties successfully more and more organization would be required, and in this organization the chemical societies would have to take part. It was even conceivable that they might have to rationalize themselves.

Sir Arthur then said that he would like to couple this toast with the name of Prof. Morgan who, he said, was too well known to require any introduction. He would like to say that so long as the leaders were men of the calibre of Prof. Morgan, chemists would go from strength to strength and exert more and more influence on the industry of the country and the profession would remain one to which members would be proud to belong.

Prof. G. T. Morgan responded to the toast and said that, in his student days, Hadrian's Wall used to be regarded as a kind of semi-permeable membrane which allowed chemists to pass from north to south but which prevented passage in the opposite direction. Nowadays this was no longer the case. He was very proud to be present on this occasion, even more so as he came as the president of the oldest chemical society. The Chemical Society, which was now in its 92nd year, had had 44 presidents, of which about one-third were Scotsmen. He mentioned the recent report on the Scottish Chemical Industries and thought that it was rather pessimistic, though he said that it contained no mention of what he considered as one of the most thriving of Scottish industries, the Carnegie Trust. He said that during the last four years the Trust had made possible the research of between 70 and 80 Scottish chemists. He then said that he had been interested to learn from Sir Arthur that Sir William Perkin had been associated with the Royal Technical College. Since Perkin's days great strides had been made in the dyestuffs industry, but he thought that one of the most remarkable advances was the development of this industry in Scotland. Prof. Morgan concluded by outlining some of the remarkable achievements of Sir William Ramsay and mentioned some personal contacts which he had had with him.

The toast of "The Guests" was proposed by Dr. William Cullen, and Dr. J. T. Dunn, President of the Society of Chemical Industry, replied. The health of Sir Arthur and Lady Huddleston was proposed by Mr. John MacCallum the Convener of the Dinner.

After the dinner there was an enjoyable programme of dancing, which continued until 2 a.m.

CHEMICAL SOCIETY

Eighty-six new Fellows were elected at an ordinary scientific meeting held on December 7. The President, Prof. G. T. Morgan, O.B.E., F.R.S., occupied the chair.

Prof. W. E. Garner discussed :

The Thermal Decomposition of Solids. [With A. S. Gomm and H. R. Hailes.]

The thermal decompositions of crystals of α-lead azide, mercury fulminate, lead styphnate, and barium azide have been shown to possess certain features in common. After an initial quiescent period, the reactions accelerate and the acceleration follows the equation $\log_e dp/dt = k_1t +$ constant, and towards the end of the decomposition the reactions obey the unimolecular law.

The course taken by these reactions is not in agreement with the view that the centres of decomposition increase in radius at a uniform rate. It is suggested that the boundaries of the mosaic structure of crystals and the surfaces of crystallites hinder the free passage of the reaction. As a consequence, the nuclei grow by a branching mechanism, the reactions spreading by suitable bridges from grain to grain.

The Acceleration of the Decomposition of Solids by the Emission from Radium. [With C. H. Moon.]

The thermal decomposition of crystals of barium azide is accelerated by the emission from radium. The effect is probably due to an acceleration of the growth of the nuclei and not to an increase in their number. The thermal decomposition of mercury fulminate is unaffected by the emission from radium.

Sir Robert Robertson referred to the importance of investigations on the decomposition of solids, and recalled the increasing number of instances in which proof is extending that crystals are traversed by Smekal cracks. He asked if the incidence of nuclei from which decomposition spreads is not more likely to be on the boundaries of the tesseræ into which the crystal may be divided rather than in the substance of the tessera itself, as the energy of the structure might be higher than normal on an edge. He suggested this in the light of work which had been going on in the Government Laboratory on the photoelectric properties of diamond, for diamonds which have a photoelectric response are characterised by being mosaic ; the current appeared to flow between laminations and to be due to the greater ease of removing electrons by light when these are attached to carbon atoms on the edge of a tessera. The speaker referred also to the preliminary period of small evolution of gas when fulminate is heated, as first described by Dr. Farmer, the reason for which seemed still somewhat obscure, and he suggested that during this period of heating the crystal might undergo unequal expansions giving rise to the Smekal cracks.

Dr. R. C. Farmer referred to the normal decomposition of mercury fulminate and a subsidiary reaction in which gases other than carbon dioxide are evolved. This latter shows no change in velocity at the end of the normal quiescent period. He asked whether any substances had been found which accelerated or retarded the decomposition, and referred to the anomaly that whereas small particles of mercury fulminate give a shorter induction period than large particles, the behaviour is reversed in the case of lead azide. The evidence on breaking stress appears to indicate that the Smekal cracks follow the crystal planes. When partially decomposed mercury fulminate is examined under polarised light, the decomposition is seen to proceed from the edges of the crystals to the centre in lines parallel to the edges. Dr. Farmer also raised the question whether the inter-

pretation put forward by Prof. Garner was applicable to all solid compounds, *e.g.*, to organic unionised compounds, which show a very different mechanism of decomposition.

Mr. J. A. Walters asked whether the rate of reaction of barium azide can be reduced by crushing, as in the case of fulminate, and whether the authors considered it possible to control the reaction for slow decomposition of large quantities.

Prof. Garner replied that the occurrence of discontinuities in crystals is generally accepted. It is doubtful if in all cases these discontinuities are due to the structure postulated by Smekal and Zwicky: in some cases they may be due to the heating of the crystals. The branching mechanism put forward to account for the induction period assumes that the reaction is hindered at the discontinuities. The nuclei are probably formed on the edges of units of the structure. The decompositions of lead azide and mercury fulminate are different in type. In the former the surface rapidly becomes covered with metallic lead and the rate of the reaction is then approximately linear. It is only in the initial period before the surface is covered that the branching mechanism holds. Since the surface plays a greater part when the crystals are small, the branching phenomena are best observed with small crystals. In mercury fulminate the centres are more widely distributed, and hence even for single crystals the mechanism holds for a considerable part of the reaction. It holds for a still larger fraction of the reaction if the crystals be ground. The experimental results for both solids are in accord with the theory. No experiments were carried out to determine whether α-, β-, or γ-rays were the cause of the acceleration of the decomposition of barium azide. The rate of decomposition of large quantities of barium azide can be reduced by the addition of sand.

Dr. F. Fairbrother discussed:

The Dielectric Polarisation of Hydrogen Chloride in Solution. Part II. Benzene. Ethyl Bromide and Ethylene Dichloride.

In a previous communication it was shown that the dielectric polarisability of hydrogen chloride in solution in benzene, *cyclo*hexane and carbon tetrachloride was greater than the polarisability in the gaseous state. The present paper is a continuation of the work, including two solvents of higher dielectric constant, ethyl bromide and ethylene dichloride, and also a repetition of the benzene measurements with much improved technique, particularly as regards purification of the hydrogen chloride and the estimation of its concentration in the solutions. The results obtained for benzene are in excellent agreement with those previously obtained. The results for the solutions in ethyl bromide and ethylene dichloride, on the other hand, lead to values of the electric moment which are close to the value for the moment in the gaseous state.

Prof. S. Sugden asked whether there was any evidence of the molecular condition of HCl in benzene solution. If there was association to H_2Cl_2 it might account for the higher polarisation.

It must be remembered that the application of the Clausius-Mosotti equation to substances in solution was a pure hypothesis and had not the same validity as in the gaseous state. The hypothesis certainly seems to be justified by many experimental data, but the anomalous results with benzene solutions may possibly be connected with deviations from this relation.

Dr. H. O. Jenkins said that any conclusions reached for the behaviour of HCl in different solvents must apply to nitrobenzene. The apparent moment of this varies linearly with the dielectric constant of the medium. No special significance attaches to non-polar solvents. The conditions for the accurate determination of an electric moment in solution are not known.

Dr. Fairbrother replied that he did not believe that association of hydrogen chloride into double or greater molecules was a cause of the observed increase of electric moment; the work of Gray and Burt on the density of hydrogen chloride shows that the gas has no tendency to associate at atmospheric pressure, and one would not expect such an association in benzene solution. The freezing point experiments of Beckmann and Lockemann (Z. physikal Chem., 1907, **60**, 385), however, in benzene and nitrobenzene suggest some interaction between solvent and solute in the more dilute solutions; these authors found that HCl appeared to be more associated in nitrobenzene than in benzene, and more at *greater* dilutions. These observations could be explained by the formation of loose complexes by polarisation. The independence of concentration of the author's values for the polarisation of HCl was also an argument against the association of hydrogen chloride molecules with one another. Dealing with the question of the applicability of the Debye equation to solutions in non-polar solvents, the author remarked that this procedure had been advocated by Debye and since used by many workers. Where parallel estimations of the electric moment in the gaseous state and in solution were available, it was generally found either that the results were close together or that the value in solution was *less* than in the gaseous state. The experimental evidence as yet available was insufficient to show whether the electric moment of many compounds was dependent on the dielectric constant of the non-polar solvent used for the measurements.

Mr. R. O. Gibson discussed:

The Effect of Pressure on the Binary System Monomethylaniline–Dimethylaniline. [With J. C. Swallow.]

An apparatus for the visual observation of crystallisation phenomena in liquid systems under pressure is described and the methods used for the study of the effect of pressure on the freezing points of a pure substance and on binary mixtures given. The results are recorded of the effect of pressures

up to 2000 atm. on the freezing point of pure dimethylaniline and on a series of mixtures of dimethylaniline and monomethylaniline.

Replying to questions, Mr. Gibson said that he had no idea of the stresses in the glass windows when these were under pressure. If the glass is viewed through crossed Nicol prisms, the dark field gradually contracts to a Maltese cross and eventually disappears, coloured patches appear round the edges, and, if the pressure is increased further, the windows break down. The monomethylaniline was carefully purified; there is no record in the literature of a definite m.p., all previous workers observing that it sets to a glassy solid.

THE CERAMIC SOCIETY

The autumn meeting of the Ceramic Society (Refractory Materials Section) was held in London on November 21–23, at the rooms of the Chemical Society, Burlington House. The chairman of the Section, Col. A. Stein, M.C., presided, the attendance including members from most parts of the country, and a very full programme was carried out.

F. H. Clews and A. T. Green commenced with a paper entitled "The Permeability of Refractory Materials to Gases. Part III. Experiments at Temperatures up to 850° C."

Previous work having been confined to temperatures up to 500° C., the authors proceeded to investigate the effects of higher temperatures up to 850° C. on the permeability to nitrogen of 13 representative fireclay and silica products. Available apparatus and experimental conditions precluded the authors from carrying out actual tests at higher temperatures, but from the results obtained can be inferred approximate values of the coefficient of permeability at the still higher temperatures to which most refractories are subjected in service.

The permeability decreases with rise in temperature in a manner almost independent of the nature of the material and the value of its permeability coefficient at ordinary temperatures. For a temperature increase from 10° to 500° C., the permeability is reduced to almost 0·5 of its value, and from 10° to 850° C. to a little below 0·4 of its value. For silica materials the values are slightly less. The increase in the viscosity of the gas with rise in temperature is shown to account almost quantitatively for the decrease in permeability.

The same authors presented a second paper on "The Significance of Permeability to Gases in Relation to the Texture and Industrial Usage of Refractory Materials."

Texture can only be described qualitatively, though certain properties on which it may depend can be more or less quantitatively defined as porosity, which is measured by the percentage of voids in the total volume. This measurement reveals nothing concerning the number or average dimensions of the pore spaces. Permeability to gases, defined as the readiness with which the gas will pass through the material under a definite difference of pressure, is a separate property readily capable of quantitative measurement, which also depends on the number and average dimensions of the open pore spaces, but in a different manner from that of apparent porosity. In conjunction the measurements of porosity and permeability will give information regarding the character of the pore system. Whereas permeability is directional—being measured in the direction of the flow of the gas, which can be varied at will—porosity is a three-dimensional property. The permeability of a given material in three different directions can be compared. In various standard-sized bricks the permeability has been found least almost without exception, when measured perpendicular to the 9 in. × 4½ in. face.

Whether the manufacturer's aim is towards complete homogeneity of his products or the controlled development of a denser surface material, measurements of permeability provide a sensitive control—much more sensitive than measurements of porosity.

The next paper was by C. R. F. Threlfall, on "Porosity," in which he discussed spalling, porosity and grading, packing of particles, de-airing, porosity due to making faults, and porosity and thermal conductivity. This paper—and others—will be published in full in the Ceramic Society's *Transactions*, in which the very interesting discussions evoked by the several papers will appear.

J. M. Coon followed with a paper on "The Microscopy of Silica Bricks, with Special Reference to the Inversion Forms of Silica."

Diagrams and excellent lantern slides, many produced from microphotographs, along with several actual microscope slides of materials used, assisted Mr. Coon to explain the mineralogical structure of various silica materials, including evidences of fluxing action, different characteristics of the different varieties of silica, the transition from one form to another, etc. The sections were prepared from raw ganister, various types of silica bricks, pure fused silica, vertical gas retort, etc. Some reference was made to chemical composition, but greater consideration was given to the optical properties.

A paper by Donald Turner, B.Sc., was concerned with "Special Refractories for Metallurgical Research at High Temperatures."

The work was done in the metallurgical department of the National Physical Laboratory. It deals mainly with refractories developed specially for use in researches on alloys of iron. Refractory crucibles were required to contain metals at temperatures above 1600° C. without contaminating the molten charge. Thin-walled cylindrical crucibles were also needed.

The crucible proper is fitted loosely into an outer sleeve of strong refractory material, leaving room for a packing of loose alumina powder consolidated by lightly tapping the sleeve during the packing process. This arrangement of crucible, packing, and sleeve has proved highly successful. Pure alumina is an

excellent refractory for many purposes, especially under reducing conditions. For thin-walled alumina crucibles slip-casting methods are used.

Crucibles have also been made of pure magnesia and pure thoria. Beryllia crucibles have been made from calcined beryllium oxide; they are white, hard, and very refractory, but have not been used for ferrous alloy melting. For certain iron silicon alloys, crucibles prepared from crystalline silica were used.

A paper by W. H. Tyler and W. J. Rees was entitled "An Investigation into the Commercial Utility of a Deposit of Magnesite-bearing Rocks in the Anglo-Egyptian Sudan."

The Sudan rock is essentially a mixture of talc and ferruginous crystalline magnesite, the accessory minerals being chiefly chromite and magnesite.

The main portion of the deposits has an average composition of nearly 50% talc with over 40% magnesite, the rest being made up of iron carbonate (combined with the magnesite), with alumina and chrome spinels, and magnetite. This rock was mixed with various proportions of dead-burnt specian magnesite, made into briquettes, and the fired (at 1500° C.) briquettes examined. It was found that equal parts of magnesite and Sudan rock gave the best products.

The use of a rock requiring no dead-burning, as a substitute for 50% of the material composing a magnesite brick all of which has to be dead-burnt, suggests commercial possibilities. Low-cost mining methods can be employed for production, and, if reasonable transport charges can be arranged, it should be possible to deliver the material in British ports at less than £4 per ton. This would mean considerable saving in the raw material costs, and, owing to the softness of the Sudan rock as compared with the extremely hard dead-burnt magnesite, the grinding cost would also be substantially reduced.

A paper by J. H. Chesters and C. W. Parmelee followed, on "The Burning of Magnesite Bricks. Part I."

The work described in this paper follows two previous papers by Chesters and Weyl, relating to "Souring" and "Drying" respectively.

In two Austrian magnesites containing 7% and 4% iron oxide respectively, the burning shrinkage set in at about 1000° C., increasing rapidly up to 1400° C. Shrinkage rate was greatest for a few minutes before and after maximum temperature was reached, and two hours later it was about one-twentieth of the maximum rate. The magnesite with 4% iron oxide showed almost as much linear shrinkage at 1450° as at 1500° C., but the other magnesite much less. With both magnesites the shrinkage at 1400° was very much slower. Shape of shrinkage curves suggests that the main shrinkage occurs when the glassy bond softens and draws the grains together. Porosity determinations showed that most of the burning shrinkage was due to decrease in porosity, and only a little to increase in density of the magnesia.

The next paper was by W. Hugill, H. Ellerton, and A. T. Green, on "The Action of Carbon Monoxide on Refractory Materials. Parts I and II."

Both parts of this paper are concerned with experiments on the disintegration of fireclay products by carbon monoxide, at temperatures of 350°–600° C. in Part I and at 420° C. for 200 hours in Part II.

There does not appear to be any direct relationship between the amount of "iron" in a brick as determined by chemical analysis and the disintegrating tendency. There appears to be some connexion between the amount of that ferruginous matter which can be separated by bromoform and the disintegrating tendency.

All the bricks, the "iron spots" of which contain a "blue-black crystalline" material bounding the cavities, show breakdown in the monoxide test. There is no suggestion of these crystals in the materials which do not disintegrate, the "iron spots" in the main appearing as brown cavities.

Of 11 different types of fireclay products exposed for 200 hours at 420° to carbon monoxide, only three entirely resisted disintegration.

In an analysis of the factors influencing disintegration it is indicated that the character of the iron compounds present in the brick is the most important. This factor seems to mask the others.

Further work on a ferruginous fraction of one product obtained by the use of bromoform as a gravity separator showed that this fraction is very highly ferruginous, and that its presence is the cause of carbon deposition.

J. C. Green then spoke on "Cupola Linings."

Present methods for both brick linings and rammed linings are very unsatisfactory, especially as regards the lining in and near the melting zone, which is the most costly to maintain. Cupola control, and especially slag control, need more attention than they usually receive.

It is stated that a satisfactory one-piece rammed lining can be applied by using a cement gun, the grog and clay, mixed with the exact amount of water necessary to give adequate binding, being shot at high pressure from the nozzle of a cement gun upon the walls of the cupola. It is possible that a cement gun in a foundry might be a very useful tool for applying the daily patch.

It is suggested that close co-operation between foundrymen and manufacturers of linings would go a long way towards solving the problem of an adequate lining for the melting zone.

A paper by J. E. Priestley and W. J. Rees was entitled "High-frequency Furnace Linings and the Results of the Investigation of Several Lining Failures," and dealt with the high-frequency induction furnaces now used in the Sheffield district for making steel.

The final paper, by C. Edwards, was headed "Notes on the Testing of Refractory Materials."

Commenting on the after-contraction test, several points needing attention in order to get reliable results are alluded to. It is stated in connexion with

the permissible variation of temperature by $\pm 20°$ C. during the test, that some bricks if held for 15 minutes at 1430° C. (20° above the specified average temperature of 1410° C.) would suffer increased after-contraction sufficient to carry the total beyond the specification limit. It is therefore suggested that the tolerance for temperature variations should be reduced to $\pm 10°$ C.

As regards the refractoriness test, the advantages of the new "safety test" as compared with the old squatting test are discussed, as well as other circumstances associated with the test.

The refractoriness under load test is also discussed, and it is noted that the average English or Scotch firebrick, under a load of 25—50 lb. per sq. in., commences to collapse at as low as 1250° C., though it is often stated that they will withstand 1400° C. under such loads.

SOCIETY OF GLASS TECHNOLOGY

The opening meetings of the 1933—34 Session were held in Sheffield on November 17 and 18, under the chairmanship of the President, Mr. G. V. Evers.

On the evening of November 17 Dr. J. C. Hostetter, President of the American Ceramic Society, and Mrs. Hostetter, were welcomed at an informal dinner at the King's Head Hotel, Sheffield. After dinner Dr. Hostetter gave a brief review of "Present Conditions in the American Glass Industry." Glass manufacture, he said, was the oldest industry in North America, dating from the year 1608. He indicated some of the changes which had taken place in the interval, notably in the plant used and in the consolidation, at present, of separate units into corporate bodies. As regards research work, the relation between viscosity and temperature was a dominant factor. Dr. Hostetter went on to speak of the revolution which had taken place in processes and machinery for making sheet and plate glass. Reference was made in passing to ultra-violet transmitting glass and to heat-absorbing glasses. Pictures of future dwellings were conjured up by descriptions of show houses built of glass in the form of bricks or plates. Reference was made to a Pyrex glass panel 15 ft. high and 5 ft. 5 in. long, recently installed in the New York City radio station. Glass for neon lighting and for pipe-lines for chemical manufacture were also mentioned. In conclusion Dr. Hostetter paid tribute to the excellent educational work on glass technology at Sheffield University.

On the morning of November 18 a visit was paid to the glass works of the British Thomson-Houston Co., Ltd. at Chesterfield. Excellent arrangements for the tour of the works were made by the manager, Mr. A. E. Hill.

The ordinary general meeting of the Society took place on the afternoon of November 18, when Mr. G. V. Evers delivered his presidential address. After surveying the work and activities of the Society during the past seven years, Mr. Evers dealt with the firebrick industry, with which he was intimately connected. The importance of the industry was emphasized during the war when the authorities published their list of protected industries, and they found the firebrick trade placed third in order of importance, being second only to shipbuilding and coalmining. The deeper one delved into the subject the more complex it became. With increased temperatures and increased outputs the severity of working conditions was always on the increase, from the firebrick maker's point of view. How were those difficulties to be faced? He believed that there was only one way, namely, by the fullest possible co-operation between maker and user. One of their difficulties was the time factor.

The actual broad lines of firebrick manufacture were simplicity itself. Mr. Evers went on to describe how fireclay occurred in the Stourbridge area of England. Seams of fireclay might be geologically and chemically similar, but were very different in their workability and ultimate physical properties as bricks. Firebrick making was an exacting, absorbing, and exciting battle, yearly, weekly, and daily. His only regret was that there was no opening for the slightest artistic feeling. That indeed was a loss.

The remainder of the meeting was devoted to the hearing of reports from some of those who attended the International Congress on Glass and Ceramics held in Italy in September, 1933. Those who spoke were Dr. J. C. Hostetter, Mr. Edward Meigh, M.B.E., Dr. J. H. Partridge, Mr. W. J. Rees, Mr. T. Teisen, and Prof. W. E. S. Turner.

THE INSULIN CASE

A tribunal appointed under Section 1 (5) of the Safeguarding of Industries Act 1921, as amended by the Finance Act 1926, sat in the Conference room of the Board of Trade, Great George Street, London, on Nov. 17, 1933, and on subsequent dates, to hear an application by the Association of British Chemical Manufacturers that insulin is a fine chemical and is included in the category of substances liable to a duty. The Board of Trade, supported by Messrs. C. L. Bencard, Ltd. opposed the application. Mr. Trevor Watson, K.C. and Mr. Basil Drewe appeared for the Association, Mr. L. F. Heald for the Board of Trade, Mr. R. Moritz, K.C. and Mr. F. R. Dymond appeared for Messrs. Bencard. Evidence was given by Prof. R. Robinson, F.R.S., Prof. J. C. Drummond, Dr. F. H. Carr, and Dr. E. F. Armstrong, F.R.S. The tribunal consisted of the Hon. S. O. Henn Collins, C.B.E., K.C., Referee, Prof. F. G. Donnan, C.B.E., F.R.S., and Prof. S. Smiles, O.B.E., F.R.S. It was announced on Dec. 6 that a majority of the members of the tribunal had decided that "insulin and its salts" should be added to the list of substances liable to duty and the list is being amended accordingly with effect as from Dec. 14, 1933.

The British manufacturers of insulin have undertaken that this decision will not lead them to raise the price of insulin.

OBITUARY

COLONEL SIR FREDERIC NATHAN

We regret to announce that Col. Sir Frederic Lewis Nathan, K.B.E., a past-president of the Institution of Chemical Engineers, died last week at the age of 72. Sir Frederic served for some years in the Royal Artillery, and held a number of official posts. In 1892 he went to the Royal Gunpowder Factory at Waltham Abbey as officer in charge of the danger building, later becoming superintendent of the factory; he was knighted in 1906. From 1909 to 1914 he was works manager of the Ardeer factory of Messrs. Nobel's. Soon after the outbreak of war Sir Frederic joined the Admiralty, where he was responsible for the building of the

Royal Naval Cordite Factory: later he went to the Ministry of Munitions, where he was Director of Propellant Supplies. During this period he did work of great importance, his position involving complete control of the soap trade and the distillery trade of the country in connexion with supplies of glycerin and alcohol, and the harmony existing in these trades generally throughout the war and the efficiency and economy of the Propellants Department are a lasting monument to his powers of control and tact.

In 1920 Sir Frederic was appointed power alcohol investigation officer of the Fuel Research Board of the Department of Scientific and Industrial Research, with which he continued to work until his death. Notes on his other post-war activities were given in the Sept. 2, 1932 issue of this JOURNAL. Sir Frederic was President of the Institution of Chemical Engineers from 1925 to 1927.

CORRESPONDENCE

THE USE OF THE WORD "CELLOPHANE"

Sir,—On p. 990 of CHEMISTRY AND INDUSTRY of Dec. 8, 1933, we observe an article entitled "The Use of Cellophane in the Determination of Humidity," throughout which the word "Cellophane" is used as though it referred to the substance under review.

We would like to draw your attention to the fact that "Cellophane" is a registered trade mark, and that in this country it can lawfully be used only in connexion with the *transparent cellulose film* supplied by this company, and that in no circumstances can it be used to denote the substance or any transparent material.

The manner in which our brand name has been used in your article is therefore erroneous, and whilst in this instance it may have been due to ignorance it is sufficiently serious from our point of view to ask you to be good enough to note the foregoing information for the future, and thus co-operate with us in protecting a valuable trade mark which is recognized as our exclusive property.

The same remarks apply to another paragraph entitled "Printed Cellophane in the Post," on p. 996 of the same issue.

When used specifically the trade mark "Cellophane" should be spelt with a capital C and placed between inverted commas, and when referring to the substance the generic description "transparent cellulose film" should be used.

Thanking you,

We are, Sir, etc.,
THE CELLOPHANE CO., LTD.

London, W.1
Dec. 11, 1933

PERSONAL AND OTHER ITEMS

We regret to announce the death last August of Dr. G. B. Mascioni, who had been a member of the Society for nearly fourteen years. Dr. Mascioni was connected with the Society of Chemical Industry in Basle, a Swiss firm in association with the Clayton Aniline Co. in this country.

The death is announced of Mr. W. F. Henderson of Newcastle, who was at one time associated with the chemical industry and was an original member of the Society.

Dr. A. J. Rudge, a member of the Society, has left the Newcastle factory of the Robert Sinclair Tobacco Co. to take up a position in the Central Laboratory of I.C.I., Ltd. at Widnes.

We regret to announce the death of Dr. George Tate, for many years a teacher of chemistry at Birkenhead and Liverpool and until recently a consultant in the latter city. Dr. Tate had been a member of the Institute of Chemistry since 1888, and had served on the council. He contributed a number of papers to chemical journals.

We regret to learn of the death recently at the age of 67 of Mr. J. Kershaw, a director of F. W. Berk & Co., with whom he had been associated for more than fifty years.

Chemical Research Laboratory

The third annual dinner of the Teddington Chemical Research Laboratory Association was held at the King's Head Hotel, Twickenham, on Tuesday, December 5, under the chairmanship of Prof. G. T. Morgan, O.B.E., D.Sc., F.R.S., President of the Association and Director of the Laboratory.

The sporting and social character of the Association received recognition by the presentation during the evening of a Sports Challenge Cup to be competed for among members of the laboratory and dedicated to the late Sir Richard Threlfall, G.B.E., F.R.S., the first Director of the Laboratory.

Speakers at the dinner referred to the outstanding success of the laboratory during the year in sporting encounters with other institutions, notably in winning the inter-departmental football, cricket, indoor games, swimming, and tennis (men's doubles) competitions organized by the National Physical Laboratory. As a result of this all-round proficiency, the Chemical Research Laboratory was a strong candidate for the Stanton Trophy, awarded for the greatest aggregate success in these competitions.

Following upon the dinner, entertainment of a varied nature was provided by members of the Laboratory and the proceedings concluded with a hearty rendering of favourite community songs.

Chemical Society's Library

The library of the Chemical Society will be closed for the Christmas holiday from 1 p.m. on Friday, December 22, until 10 a.m. on Thursday, December 28.

Poisons Board

The Poisons Board established under the Poisons and Pharmacy Act, 1933, has held its inaugural meeting and has appointed Mr. M. D. Perrins as its secretary, with Mr. K. B. Paice as assistant secretary.

Competition of Industrial Designs

In presenting a report on this year's Competition for Industrial Designs, the Royal Society of Arts regretfully announces that in consequence of the heavy costs incurred by the Society in organizing these competitions, the council has, in spite of its success as shown by the increasing number of entries during the past ten years, very reluctantly been compelled to suspend the arrangements for future Competitions of Industrial Designs until help from other sources and the necessary funds are available. It will not therefore be possible to hold a competition in 1934.

Ten competitions for designs for Architectural Decoration, Textiles, Furniture, Pottery and Glass, Book Production, Posters and Showcards, Silverware, and Leatherwork have been held since 1924, and Travelling Scholarships and prizes of the total value of £11,500 have been awarded to young students, designers, and craftsmen. These competitions have proved that there is no lack of creative talent among the younger generation, and they have undoubtedly been the means of discovering and rewarding a number of promising designers and craftsmen whose work and abilities would otherwise have been unknown.

Tin Research

With a view to co-ordinating tin research and developing the international service to tin consumers, Mr. D. J. Macnaughtan, research director of the International Tin Research and Development Council, has started a tour of investigation through the industrial centres of North America, states the *Financial Times*. The American Tin Trades Association is actively co-operating with the International Council and has formed a special body, the U.S. Tin Research and Development Committee, to facilitate development work.

COMPANY NEWS

BOOTS PURE DRUG CO.

The company announces a quarterly dividend of 6% less tax, payable on December 31. This is at the usual quarterly rate, distribution in the past few years having been 24% per annum plus a 5% bonus.

ZINC MANUFACTURING CO.

This company's accounts show a net loss for the year ended June 30 amounting to £31,038, as compared with £47,629 net loss for the previous year; the total debit on profit and loss account is now £194,090.

ILFORD, LTD.

This company reports a net profit of £94,611, against £104,682, for the year ended October 31. After payment of an ordinary dividend of 6% (as last year), £22,147 will be carried forward. The centralization of the business is proceeding, two factories having been closed, while two others are expected to close shortly.

BRADFORD DYERS' ASSOCIATION

The directors have decided to defer the preference dividend due on January 1 until the Association's accounts are available, probably in February. Payment of a dividend in July was also postponed.

BRITISH OXYGEN CO., LTD.

Under an agreement of Sept. 29, 1932, Metal Industries, Ltd. was granted an option to take up 100,000 British Oxygen shares at par. Notice has now been given by Metal Industries, Ltd. of its intention to exercise the option on Dec. 31 next. By the same agreement British Oxygen, Ltd. acquired as from Nov. 1, 1932, the oxygen business carried on by Metal Industries, Ltd. and Oxygen Industries, Ltd.

MARKET REPORT

This Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

The following alterations in prices are reported since the publication of the last Market Report (cf. CHEM. & IND., Dec. 1, 1933, p. 974).

TAR PRODUCTS

Acid Cresylic, 99/100.—1s. 8d.—2s. 3d. per gal. Refined, 1s. 9d.—1s. 10d. per gal. Pale, 98%, 1s. 6d.—1s. 7d. per gal.

INTERMEDIATES

p-Cresol 34.5° C.—2s. per lb., in ton lots.

PATENT LIST

The following is a list of complete specifications of chemical interest which are open for inspection under Section 91 (4) (*a*) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 8d. per page (minimum 1s.) from the Patent Office, Chancery Lane, W.C.2

I. 12,951 (1933). Minami. Removing fine particles suspending in electric insulating liquids.

14,547 (1933). Haskins Patent Pipe Linings, Ltd. *See* X.

14,879 (1933). Brit. Thomson-Houston Co. Testing of materials.

II. 13,352 (1933). Universal Oil Products Co. Treatment of hydrocarbon oils.

13,859 (1933). Semet-Solvay Engineering Corp. Carburetted water-gas process and apparatus.

15,274 (1933). Orelup. Stabilization of petroleum products.

III. 13,978 (1933). I. G. Farbenind. Manufacture of compounds of the acridinium series.

14,751 (1933). I. G. Farbenind. Manufacture of 1 : 4-diaminoanthraquinone-2 : 3 : *x*-trisulphonic acids.

14,796 (1933). Kalle & Co. Manufacture of diazo compounds.

14,808 (1933). I. G. Farbenind. Manufacture of solid diazo salts.

14,900 (1933). I. G. Farbenind. Manufacture of water-soluble diazoamino compounds.

15,148 (1933). I. G. Farbenind. Manufacture of naphthalene-1 : 4 : 5 : 8-tetracarboxylic acid and derivatives.

IV. 15,189 (1933). I. G. Farbenind. Manufacture of vat and sulphur dyestuff preparations for textile printing.

15,379 (1933). Du Pont de Nemours & Co. Manufacture of azo dyes.

V. 11,961 (1932). Carbide & Carbon Chem. Corp., and Eastman Kodak Co. Moistureproof materials and compositions.

15,147 (1933). Du Pont de Nemours & Co. Manufacture of cellulose esters.

VI. 14,987 (1933). Du Pont de Nemours & Co. Mercerization of textile materials.

15,189 (1933). I. G. Farbenind. *See* IV.

VII. 12,901 (1933). Amer. Zinc, Lead, & Smelting Co. Making magnesium hydroxide.

14,461 (1933). Stockholms Superfosfat Fabriks Akt. Manufacturing ammonium trinitrate.

14,462 (1933). Stockholms Superfosfat Fabriks Akt. *See* XVI.

14,731 (1933). Oxhydrique Française. Production of hydrogen.

15,307 (1933). Bozel-Maletra Soc. Ind. de Prod. Chim. Production of alkali phosphates.

VIII. 14,729 (1933). Röhm & Haas Co. Laminated glass.

IX. 14,592 (1933). Curschellas. Preparing mortars, cements, concretes, betons, etc.

X. 8355 (1933). Aluminum Colors, Inc. *See* XIII.

11,965 (1933). Aluminum Colors, Inc. Coating aluminium or aluminium alloys.

14,547 (1933). Haskins Patent Pipe Linings, Ltd. Protective linings for metal pipes.

XIII. 8355 (1933). Aluminum Colors, Inc. Treating oxide coatings.

11,961 (1933). Carbide & Carbon Chem. Corp., and Eastman Kodak Co. *See* V.

11,965 (1933). Aluminum Colors, Inc. *See* X.

12,808 (1933). Soc. Anon. des Anc. Etabl. Braunstein Frères. Carbon papers and like transfer materials.

XVI. 14,462 (1933). Stockholms Superfosfat Fabriks Akt. Manufacturing fertilizers from raw phosphate.

XIX. 11,930 (1933). Murray Deodorizers. Pasteurizing and deodorizing lacteal fluids under vacuum.

XXI. 12,651 (1933). Nordmann. Colour photography.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Belgium:* Chemical colours in powder (B.Y. 7711). *Egypt:* Oils etc. for soap-making (B.Y. 7714). *Greece:* Non-ferrous metals in ingot (642). *Holland:* Industrial chemicals, including caustic soda, bicarbonate of soda, etc. (644).

Key Industry Duty

The Treasury has made an Order under the Finance Act 1926, exempting from Key Industry Duty amido guanidine sulphate and fermentographs, being instruments for measuring and recording carbon dioxide evolved during dough fermentation, from December 12, 1933 to December 31, 1934, and continuing the exemption from Key Industry Duty till December 31, 1934, of the articles specified in the following list:

Integrators (planimeter type); amorphous carbon electrodes over 3 ft. long, the cross section of which exceeds 12 in. in both length and breadth with longitudinal slots exceeding 2 in. in width and 4 in. in depth; mercury vapour rectifiers having mercury cathodes, of a capacity of more than 200 amps. and having more than three main anode terminals;

The oxides of the following rare earth metals: celtium, dysprosium, erbium, europium, gadolinium, holmium, lutecium, neodymium, praseodymium,

samarium, terbium, thulium, ytterbium, yttrium; and compounds of scandium; vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture;

The following fine chemicals and reagents: acid adipinic, acid isobutyl allyl barbituric, acid oxalic, acid propionic, amidopyrin, ammonium perchlorate, barbitone (veronal), bromural, butyl methyl adipate, calcium gluconate, chinoline (quinoline), chinosol, cocaine (crude), dial (acid diallyl barbituric), dicyandiamide, didial (ethyl morphine diallyl barbiturate), dimethyl sulphate, diphenyl, diphenyl oxide, elbon (cinnamoyl para oxyphenyl urea), ethyl abietate, ethyl cellulose, ethylene bromide, eukodal, furfurol, germanium oxide, glycol ethers, guaiacol carbonate (duotal), lead tetraethyl, lipoiodin, metaldehyde, methyl cellulose, methyl cyclohexanol methyl adipate, methyl sulphonal (trional), methylene chloride, nickel hydroxide, oxymethyl paraoxyphenyl benzylamine methyl sulphate, papaverine, phenazone (antipyrin), *p*-phenetidine, phloroglucin, phytin, piperazine (diethylene-diamine), R. potassium chlorate, potassium ethylxanthogenate (potassium xanthogenate), potassium guaiacol sulphonate (thiocol), R. potassium hydroxide, R. potassium permanganate, pyramidon-veronal, quinine ethyl-carbonate, radium compounds, salol (phenyl salicylate), sodium ethyl methyl butyl barbiturate, strontium carbonate, strontium nitrate, styracol (guaiacol cinnamate), sulphonal, synthalin, urea.

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during November has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 753, of which 672 were from merchants or importers. To these should be added the 4 cases outstanding on October 31, making a total for the month of 757. These were dealt with as follows: Granted 737 (of which 736 were dealt with within 7 days of receipt); referred to British makers of similar products 19 (of which 14 were dealt with within 7 days of receipt); outstanding on November 30, 1. Of the total of 757 applications received, 750 or 99% were dealt with within 7 days of receipt.

Import Duty on Granite and Quercitron

The Import Duties Advisory Committee gives notice that it has under consideration an application for an increase in the import duty on granite, dressed, polished, carved, or otherwise worked. Any representations should be addressed to The Secretary, Import Duties Advisory Committee, Caxton House, Tothill Street, London, S.W.1, not later than January 1, 1934.

The Committee states that the application for the addition to the free list of quercitron bark included in its announcement of November 29, 1933, should be read as relating to quercitron bark extract.

Change of Address

The address of Liptak Furnace Arches, Ltd. has been changed to 59, Palace Street, Victoria Street, Westminster, London, S.W.1. The telephone number remains, as before, Victoria 0713.

Ventilation of Buildings

The problem of continuously renewing the atmosphere of a building without creating undesirable draughts is often a difficult one. For many purposes a satisfactory solution is the "natural" method of ventilation, involving the use of wind-operated extractors together with suitable inlets for fresh air, and the "Harco" Extractor Ventilators made by G. A. Harvey & Co. (London), Ltd., Woolwich Road, S.E.7, will then be found to be efficient. In workshops and factories where dust, fumes, etc. have to be rapidly removed a "mechanical" form of extraction involving pipes and fan extractors may be required; the wide experience of the same firm makes it equally competent to undertake work of this kind.

PUBLICATIONS RECEIVED

Fundamentals of Biochemistry: In Relation to Human Physiology. By T. R. Parsons, B.Sc., M.A. Pp. xii + 435. Cambridge: W. Heffer & Sons, Ltd., 1933. 10s. 6d.

Annual Report of the Royal Technical College, Glasgow, on the One Hundred and Thirty-seventh Session adopted at the Annual Meeting of Governors held in October, 1933. Pp. 84. Glasgow: R. Anderson & Sons, Ltd., 1933.

Report of the Fuel Research Board for the Year ended March, 1933. With Report of the Director of Fuel Research. Department of Scientific and Industrial Research. Pp. viii + 140. London: H.M. Stationery Office, 1933. 2s. 6d.

Transactions of the Institution of Gas Engineers, 1928—29. Vol. 78. Pp. vi + 490. 1929—30. Vol. 79. Pp. vi + 914. London: Institution of Gas Engineers, 1933.

Principles of Metallurgy. By D. M. Liddell and G. E. Doan, Ph.D. Pp. vii + 626. New York and London: McGraw-Hill Book Co., Inc., 1933. 30s.

Theory of Industrial Gas Heating. By P. Lloyd, B.A., A.I.C. With a Foreword by S. Lacey, B.Sc. Pp. x + 104. London: W. King, Ltd., 1933. 6s.

Die Technik der Chemischen Operationen. By Dr. W. Bader. Pp. 416. Basle: B. Wepf & Cie., 1934. Paper, 18 fr. S.; bound, 20 fr. S.

Der Chemie-Ingenieur. Edited by A. Eucken and M. Jakob. Vol. II. Physikalische Kontrolle und Regulierung des Betriebes. Part 3. Messung von Zustandsgrössen im Betriebe. Edited by M. Jakob. Rewritten by H. Ebert and others. Pp. xi + 275. Leipzig: Akademische Verlagsges., 1933. Paper, 26 rm.; bound, 28 rm.

Die Physikalischen und Chemischen Grundlagen der Keramik. By Dr.-Ing. H. Salmang. Pp. viii + 229. Berlin: J. Springer, 1933. 18 rm.

List of Members of the Institution of Mining and Metallurgy. Constitution and By-Laws and Royal Charter of Incorporation. November, 1933. Pp. 150. London: Institution of Mining and Metallurgy, 1933.